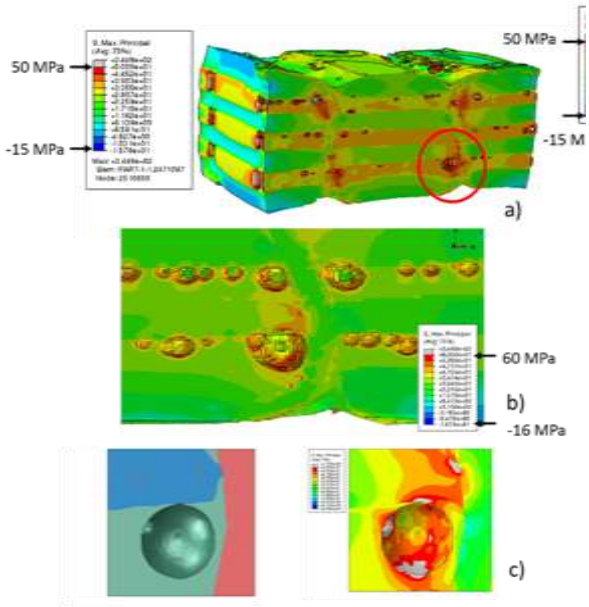
Master's Internship Subject



Duration: max 6 months
Laboratory : P' Institute – ISAE-ENSMA
City : Poitiers (France)
Collaboration : Safran Composites
Supervisors :
Dr. Y. Pannier, Pr. M. Gigliotti, Pr. J.-C. Grandidier – M. Gueguen

Image Based FE modeling of damage mechanisms during in-situ multiaxial tests of 3D woven Organic Matrix Composites

Domain: Aeronautical composite structures
Desired skills: Finite Element Method, Continuum mechanics, basic knowledge in programming (Matlab, Python or C++)
Keywords: 3D image based Finite Element Modeling, 3D woven composites, Virtual Material

Description of the laboratory

Pprime Institute (P') is a French research laboratory specialized in the fields of Physics and Engineering Sciences. It is a UPR CNRS linked with the University of Poitiers (The Faculty of Fundamental and Applied Sciences, the Faculty of Sport Sciences, ENSIP (National Higher School of Engineers of Poitiers)) and ISAE-ENSMA (National Higher School of Mechanics and Aeroengineering).

The ENDO group's activities in composites area (thermoset or thermoplastic polymer matrix) are focused on understanding, identifying and modelling of deformation and damage under close-to-real-usage conditions. A particular attention is paid to the links between local mechanisms occurring at micro and mesoscopic scales and macroscopic mechanical behaviour. The aim of our work is to provide predictive models of mechanical resistance or durability. A specificity of our approach is to take into account the environment effects (temperature, humidity, reactive or non-reactive gases...) and represent them by the multiphysics couplings of matter (between diffusion, chemical reaction, viscoelasticity...) and gradients or transient processes that influence the durability of the components.
ENDO group : https://www.pprime.fr/?q=en/damaging-and-durability-endo

Description of the subject

Organic Matrix Composites (OMC) are introduced in numerous parts of aircraft structures, in particular in the vicinity of civil or military aircraft engines. 3D woven OMC (3DOMC) have been introduced for their better impact resistance and their ability to withstand multi axial mechanical loadings. The design of 3DOMC aircraft structures is based on a perfect knowledge of the mechanical behavior and durability of the constitutive material. In addition to numerous tests carried out on specimens or on structures, finite element models (FEM) able to take into account the different levels of complexity of the material are constantly being conducted and improved. (see for ex. [Sinchuk&al2017, Gigliott2018]).

The work proposed in this internship is part of the optics to improve the understanding of the behavior of 3DOMC under multiaxial loadings through the modeling of these tests. These models take into account the complexity of the composite architecture obtained by segmentation of 3D tomography images of the material. Different strategies for meshing and taking into account the heterogeneity of the material will be conducted. The numerical results will be compared with the experimental results obtained during test campaigns carried out under X-ray micro-tomography.

References:

Gigliotti&al, *X-ray µCT Based Assessment of Thermal Cycling Induced Cracks in Non-crimp 3D Orthogonal Woven Composite Materials with Porosity,* Conference Texcomp, Milan, 2018
Sinchuk&al, *Computed-Tomography based Modelling and Simulation of the Moisture Diffusion and Sw Elling of Textile Composite Materials*, International Journal of Solids and Structures Accepted, 2017
Sinchuk&al, *Image-based Modeling of Moisture Swelling in 2D Textile Composites using a Global-Local approach*, Proc IMechE Part C: Journal of Mechanical Engineering Science, 2017

Traineeship allowance: ~550euros/month

Contact:

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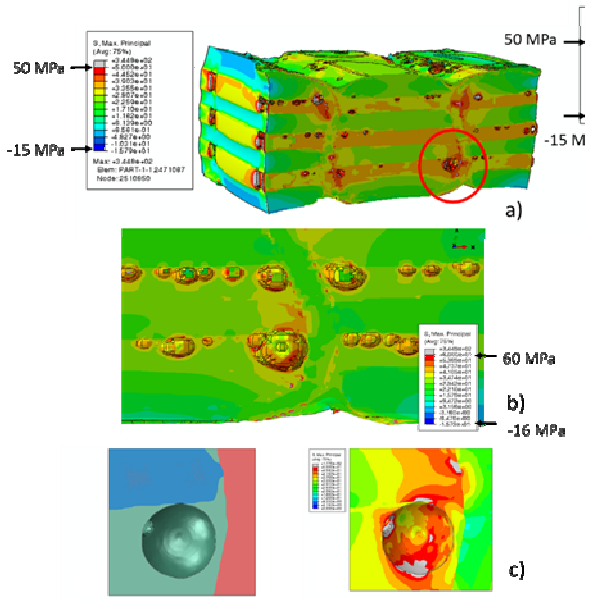
Pr. Marco Gigliotti : marco.gigliotti@ensma.fr, phone : +33 5 49 49 83 40

https://www.youtube.com/channel/UCjckbOkZI2k3oiG68yoOZ9w

https://www.facebook.com/isae.ensma86/

Master AE, parcours « Transports Aéronautiques et Terrestres »



Laboratoire : P' PMM, ENSMA - Poitiers
Collaboration : Safran Composites
Responsables du stage
Yannick Pannier, Marco Gigliotti, Jean-Claude Grandidider

Financement : indemnités du Laboratoire

Analyse par MEF des mécanismes de déformation et d'endommagement en traction/torsion/compression de CMO3D

Application et Débouchés : Optimisation et dimensionnement de structures composites aéronautiques
Outils et connaissances à utiliser : Méthode des éléments finis, techniques de maillage, programmation
Nature du travail : construction et exploitation de modèles MEF
Poursuite en thèse : non

Description

Les composites à matrice organique sont introduits dans de nombreuses structures d'aéronefs y compris dans les moteurs civils et militaires. Les possibilités offertes par les composites à tissage 3D (CMO3D) permettent également d'envisager l'optimisation de structures fortement sollicitées en multiaxial.
Le dimensionnement de ces structures nécessite une parfaire connaissance du comportement de ces matériaux. En complément des nombreux essais réalisés sur éprouvettes ou sur structures des modélisations éléments finis (MEF) capables de prendre en compte les différents niveaux de complexité du matériau sont sans cesse conduites et améliorées ([Sinchuk&al2017, Gigliott2018]).
Le travail proposé dans ce stage s'inscrit dans l'optique d'améliorer la compréhension du comportement des CMO 3D sous sollicitations multiaxiales à travers la modélisation de ces essais. Ces modèles prennent en compte la complexité de l'architecture du composite. Différentes stratégies de maillage et de prise en compte de l'hétérogénéité du matériau seront conduites.
Les résultats numériques seront confrontés aux résultats expérimentaux obtenus lors de campagnes d'essais conduites sous micro-tomographie RX.

Références :

Gigliotti&al, *X-ray µCT Based Assessment of Thermal Cycling Induced Cracks in Non-crimp 3D Orthogonal Woven Composite Materials with Porosity,* Conférence Texcomp, Milan, 2018
Sinchuk&al, *Computed-Tomography based Modelling and Simulation of the Moisture Diffusion and Sw Elling of Textile Composite Materials*, International Journal of Solids and Structures Accepted, 2017
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